Fermilab Directorate

MEMORANDUM OF UNDERSTANDING FOR THE 2007 MESON TEST BEAM PROGRAM

T970

DHCAL Detector Test

May 7, 2007

INTRODUCTION

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and experimenters from Argonne National Laboratory (HEP), Boston University, University of Iowa, and University of Texas at Arlington who have committed to participate in beam tests to be carried out during the 2007 MTBF program. The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum which will reflect such required adjustments.

The tests involve a small calorimeter consisting of a stack of steel and copper plates interleaved with Resistive Plate Chambers (built at Argonne) and Gas Electron Multiplier chambers (built at UTA). The chambers are read out with a digital readout system (developed and built by Argonne, Boston, and Fermilab). The Iowa group contributes the gas and High Voltage distribution system. The proposed tests are in the context of developing Particle Flow Algorithm Calorimetry for the ILC. The purpose of the tests is to establish the viability of the electronic readout system for calorimeters with fine granularity and to measure the performance of RPCs/GEMs in hadronic showers. The tests will take place in June/July 2007 and should be regarded as a precursor to the larger tests planned by the CALICE collaboration and the American Linear Collider Calorimetry groups.

The research on RPCs (GEMs) for hadron calorimetry was initiated at Argonne (UTA) several years ago. The work at Argonne (UTA) has been funded by DOE through strategic LDRD (LCDRD) grants. The detailed goals of this small scale beam test are listed below.

I. PERSONNEL AND INSTITUTIONS:

Physicist in charge of beam tests: José Repond, Argonne National Lab.

Fermilab liaisons: Erik Ramberg
Doug Jensen

The group members at present and others interested in the testbeam are:

1.1 Argonne: Gary Drake, Vic Guarino, Ed May, A Kreps, Jose Repond, Dave Underwood, Harry Weerts, Barry Wicklund, Lei Xia
1.2 Boston University: John Butler, Eric Hazen, Shouxiang Wu
1.3 Fermilab: Marcel Demarteau, Jim Hoff, Scott Holm, George Mavromanolakis, Ray Yarema
1.4 University of Iowa: Ed Norbeck, Yasar Onel
1.5 University of Texas at Arlington: Heather Brown, Kwon Pyo Hong, Li Jia, Wonjeong Kim, Jacob Smith, Andy White, Jae Yu

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

2.1 LOCATION
2.1.1 The experiment is to take place in the MTEST beam line, in the MT6-2A area.
2.1.2 The following items will be needed in the beam area:

- 1 19-inch rack for electronics (to house two NIM and a VME crates)
- Space for a gas distribution rack (to be brought from Argonne) close to the test set-up
- The upstream motion table, which is capable of holding the 500 lb detector assembly.
- Space in the beam line for our beam telescope, to be located in front of the motion table.

2.1.3 Additional work space will be needed in the control room, equivalent to at most two 6'x3' tables. This space will be used for the data acquisition PC and as general work space.
2.1.4 The experimenters propose to put a tank of pre-mixed gas near the gas distribution rack.

2.2 BEAM: The tests will use the slow resonantly-extracted, Main Injector proton beam focused onto the MTest target. The experimenters will need mostly 120 GeV proton beams. Due to the long recharge time of RPCs, low intensity beams (50 – 1000 Hz onto our 1 x 1 cm^2 trigger counters) are needed. Additionally, tests with low momentum pion and electron beams (1 – 8 GeV/c) will be useful.

2.2.2 BEAM SHARING: Most likely the experimenters could run parasitically downstream of some other test during most of the setup and debugging time if other tests require low rates. Because of limited manpower the experimenters cannot run continuously. Alternating with other users is possible.

2.2.3 RUNNING TIME: The experimenters estimate the need for several 8 hour periods of running time to explore the phase space of experimental conditions (various HV and threshold settings) with rates of the order of 100 Hz/cm^2. Additionally, tests with variable beam rates (to measure the rate capability of our apparatus) are required. Finally, measurements with low momentum pions and electrons (1 – 8 GeV/c) are needed. The experimenters will likely require two weeks of beam time.

2.3 SETUP: The experimental setup consists of two parts: a) a calorimeter stack (see Figure 1) with up to 10 RPCs and GEMs interleaved with steel and copper plates. The lateral dimensions of the absorber plates are approximately 30 x 30 cm^2. The total weight of the setup will not exceed 500 lbs. The stack is to be located on top of a scanning table; and b) a beam telescope consisting of 5 scintillation counters, fixed in space and located in front of the stack.

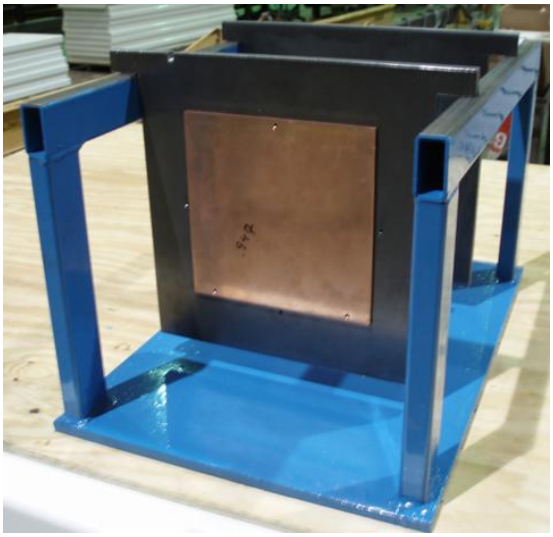

Figure 1 Photograph of calorimeter stack with two absorber plates installed

COMPUTING: The experimenters will supply their own DAQ computer. Ethernet connection (with capability of using SSH) will be required for data transmission offsite (and downloading of updated versions of firmware from outside institutes).

III. RESPONSIBILITIES BY INSTITUTION - NON FERMILAB

([] denotes replacement cost of existing hardware.)

3.1	RPCs, 20 x 20 cm^2, about 10 units ($2k each)	[$20k]
3.2	GEMs, 30 x 30 cm^2, about 2 units ($2k each)	[4]
3.3	Gas (non-flammable, 5%Isobutane and 0.5% SF6 remainder R134 Freon & 80/20 ArCO2)	[3]
3.4	Digital scope	[10]
3.5	2 PCs	[5]
3.6	NIM crate with High Voltage units	[20]
3.7	NIM crate with beam telescope logic	[20]
3.8	VME crate with custom cards and a VME-PCI bridge	[20]
3.9	Cables, voltmeters, tools, toolbox, etc…	[2]
	Total existing items	[$104K]

IV. RESPONSIBILITIES BY INSTITUTION - FERMILAB

4.1 Fermilab Accelerator Division:

4.1.1 Use of MTest beam according to Section 2 above.

4.1.2 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.

4.1.3 A scaler or beam counter signal should be made available in the counting house.

4.1.4 Reasonable access to the experimental equipment in the test beam.

4.1.5 The test beam energy and beam line elements will be under the control of the BD Operations Department Main Control Room (MCR).

4.1.6 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.

4.1.7 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.1.S Summary of Accelerator Division costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
Total new items	$0.0K	$0K	0.0

4.2 Fermilab Particle Physics Division

The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including installation of test equipment, use of the user beam-line controls, readout of the beam-line detectors, and MTest gateway computer. PPD will design and fabricate the Timing/Trigger VME module required for DCAL readout and provide the QuarkNet GPS board required for overall timing.

4.2.S Summary of Particle Physics Division costs:

Type of Funds	Equipment	Operating	Personnel (person-weeks)
QuarkNet GPS board		$150	
Trigger/Timing module		$850	10
Installation coordination			0.4
Overall coordination			0.2
Total new items	$0.0K	$1K	10.6

4.3 Fermilab Computing Division

4.3.1 Ethernet and printer should be available in the counting house.

4.3.2 Connection to beams control console and remote logging (ACNET) should be made available in the counting house.

4.4 Fermilab ES&H Section

4.4.1 Assistance with safety reviews.

4.4.2 Loan of radioactive source (preferably Sr^{90}, 0.1mCi) for the duration of the test beam.

V. SUMMARY OF COSTS

Source of Funds [$K]	**Equipment**	**Operating**	**Personnel** (person-weeks)
Particle Physics Division	$0.0K	$1K	10.6
Accelerator Division	0	0	0
Computing Division	0	0	0
Totals Fermilab	$0.0K	0	0.2
Totals Non-Fermilab	[$82K]		

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the spokesman of the DHCAL Detector Research group and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters": (http://www.fnal.gov/directorate/documents/index.html). The Physicist in charge agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating an Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The spokesman of the DHCAL Detector Research group will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer and follow all procedures in the PPD Operating Manual.

6.3 The spokesman of the DHCAL Detector Research group will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

6.5 All items in the Fermilab Policy on Computing will be followed by the experimenters. (http://computing.fnal.gov/cd/policy/cpolicy.pdf).

6.6 The spokesman of the DHCAL Detector Research group will undertake to ensure that no PREP or computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

6.7 The DHCAL Detector Research group will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

6.8 At the completion of the experiment:

6.8.1 The spokesman of the DHCAL Detector Research group is responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the spokesman of the group will be required to furnish, in writing, an explanation for any non-return.

6.8.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

6.8.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied.

6.8.4 An experimenter will be available to report on the test beam effort at a Fermilab All Experimenters Meeting.

SIGNATURES:

_____ / / 2007
José Repond, Argonne National Laboratory

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Greg Bock, Particle Physics Division

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Roger Dixon, Accelerator Division

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Victoria White, Computing Division

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William Griffing, ES&H Section

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Hugh Montgomery, Associate Director, Fermilab

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Stephen Holmes, Associate Director, Fermilab

APPENDIX I - Hazard Identification Checklist

Items for which there is anticipated need have been checked

Cryogenics		Electrical Equipment		Hazardous/Toxic Materials	
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials
	Analysis magnets		capacitor banks		planned for use in a beam line or experimental enclosure:
	Target	X	high voltage		
	Bubble chamber	X	exposed equipment over 50 V		
Pressure Vessels		**Flammable Gases or Liquids**			
	inside diameter	Type:	Isobutane (5% of a non-flammable mixture)		
	operating pressure	Flow rate:			
	window material	Capacity:			
	window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
	inside diameter	X	temporary use		Beryllium (Be)
	operating pressure	Type:	**Sr90**		Lithium (Li)
	window material	Strength:	**5 mCi**		Mercury (Hg)
	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other :
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		Lifting devices
type:			TEA	X	Motion controllers
Wattage:			photographic developers		scaffolding/elevated platforms
class:			Other: Activated Water?		Others